I. Söderströmi, in the colour of its tail, but differs both from these and *I. Stolzmanni* by the extreme hairiness of its ears, the restriction of the white of the under surface to the chest and centre of belly, and by the slenderness of its incisors.

XXI.—*On the Anatomy of* Apera Burnupi, *E. A. Smith.*

By Walter E. Collinge, F.Z.S., Assistant Lecturer and Demonstrator in Zoology and Comparative Anatomy, Mason University College, Birmingham.

[Plate V.]

The genus of slugs known as *Apera* was originally constituted by Binney (2) in 1879 under the term *Chlamydephorus*. Heynemann (6), however, suggested the term *Apera*, on the ground that Binney's name indicated a false characteristic, viz. the presence of a mantle-lobe. Later, Mr. Edgar A. Smith (8) pointed out that Agassiz (1) had employed the term *Chlamydophorus*, which is practically the same as that used by Binney, for a group of mammals, a fact which Heynemann does not seem to have been aware of.

There are only two known species of this genus, namely, *A. Gibbonsi*, W. G. Binney, from Natal (2), and *A. Burnupi*, E. A. Smith, from Natal (8).

My best thanks are due to M. Edgar A. Smith, for his kindness in supplying me with the material upon which these observations on the anatomy have been made.

The specimen from which all the figures were drawn measured 49 millim. in length. It corresponded in all external features to the original description (8). Mr. Edgar A. Smith has pointed out that the carinæ are doubtless much accentuated in alcoholic specimens; this I can confirm, for on being immersed in very weak alcohol they were much less conspicuous, the dorsum being more convex. Mr. Smith has since sent me a note of some observations he made upon a living example, in which he points out that the keels are visible but less acute than in the contracted state. In Heynemann's figures (6, T. 2. figs. 5 & 6) of *A. Gibbonsi* the keel which limits the back is not shown. This same author (6, p. 19), although only acquainted with the external features of *A. Gibbonsi*, suggested that the genus *Apera* belonged to the Testacellidæ; on p. 19 he writes:—"Dann springt uns sofort die nahe Verwandtschaft mit *Testacella* in die Augen, die gemeinsame allgemeine Gestalt (s. Fig. von Gibbons), die gemeinsame Lage der Genital-, Athem- und Afteröffnung, die ähnliche strahlige Könnelung um diese Körperöffnung herum, die ähnliche Runzelung über die Länge des Rückens (s. Figur von Gibbons und seine

Beschreibung: 'Dorsum finely sulcato-striate from head to orifice. A row of small regular tubercles runs along medial line from head to prominence'), die Seltenheit des Vorkommens, die wohl in der gemeinsamen unterirdischen Lebensweise begründet ist, und dergl. mehr."

That *Apera* has affinities with the Testacellidæ there can be little doubt, but there is a wide gap between it and either *Testacella* or *Daudebardia*.

In the generalized character of the generative organs *Apera* resembles in some ways the genus *Schizoglossa*, but until we have a more detailed account of the anatomy of this last-named genus it will be difficult to rightly classify it. There is a still wider gap between *Apera* and *Schizoglossa* than between *Apera* and either *Testacella* or *Daudebardia*. Godwin-Austen (4, p. 8) has placed *Schizoglossa* with *Ælea* and *Paryphanta* in a new subfamily *Paryphantinæ*, on the following grounds:—"In the form of the buccal mass this new subgenus (*Schizoglossa*) shows best the close relationship which it has with *Paryphanta*, both in the rounded form of the basal end and in the unification of the salivary glands, neither of which characters are to be seen in *Testacella haliotidea* which I have examined . . . In the generative organs we find this difference, the vas deferens in *Testacella* joins the male organ near the attachment of the retractor muscle at the posterior end, whereas in *Paryphanta* and *Schizoglossa* it is peculiarly short and joins the male organ very low down just above the generative aperture."

Judging from Hedley's description and figure of the generative organs of *Schizoglossa* it would appear that we have here a mollusk in which numerous modifications have taken place. The absence of any receptaculum and the generalized character and feeble development of the male organs certainly make it difficult to rightly assign it to any family of mollusks where these are predominant features. There are not a few points in which it shows an affinity to *Apera*, and through this genus to *Testacella* and *Daudebardia*; at the same time there are many points of difference.

Anatomy.

The Alimentary Canal (Pl. V. fig. 2).—There is a wide buccal cavity from which passes a long thin-walled œsophagus; at the junction of the œsophagus with the crop is a large bilobed salivary gland, which pours its secretion into the postero-dorsal portion of the buccal cavity by a single duct. In *Testacella* there are two salivary glands and two ducts, lying on each side of the crop and opening laterally

into the anterior portion of the œsophagus. The crop is a wide thin-walled sac, rather longer than the œsophagus; the stomach, which forms the terminal portion of this sac, is a small bilobed cavity hidden in the substance of the liver. In *Schizoglossa*, Hedley (5, p. 390) remarks "that the pharynx is enormous, occupying almost the whole length of the visceral cavity, and nearly equalling in size the remainder of the viscera." I take it that what I am terming œsophagus and crop correspond to what Hedley terms pharynx; if so, the two forms closely agree in this feature. The intestine in *Schizoglossa* is short, while in *Apera* it makes two loops in the lobes of the liver, and terminates as a slightly wider tube, the rectum. In *Testacella* the intestine forms a single loop.

The Pedal Gland.—Opening beneath the mouth and occupying the floor of the visceral cavity for the whole length of the animal is a large thick-walled convoluted body, the pedal gland. It is wound from right to left, as shown in figure 3 (Pl. V.), and slightly indented on its upperside. It was of a yellowish brown in colour, its free end being much lighter and more glandular; to this there was a long muscle attached. In transverse section it appeared as shown in figure 4 (Pl. V.), viz. a small lumen on the underside, and in the mass of connective tissue &c. there were present a large series of microscopic chitinous (?) dart-like bodies. These had a broad and slightly convex plate-like form at the one end, tapering at the opposite end into a long fine point (Pl. V. fig. 5). The whole tube must contain many thousands of these bodies. I should have been glad to investigate the minute structure of this organ in greater detail had I possessed the material. In this example the gland had become exceedingly hard, almost brittle, with being in alcohol, and it was only after soaking in water for two or three days that I was able to make out the few features mentioned above.

Lacaze-Duthiers (7, p. 522) has described and figured the pedal gland in *Testacella*; it is simple in structure, much longer than in *Apera*, and exhibits the same zigzag form. In *Testacella* it is enclosed in a sheath of connective tissue, which I do not find in *Apera*. The cells of the gland are filled with granules; these probably represent what in *Apera* I have described as minute dart-like bodies. From the contracted state of the gland in the specimen I had, figure 4 probably only very incorrectly represents the actual appearance.

The Generative Organs.—There is a small vagina into which the penis opens. This latter organ is a narrow tube, slightly globose at the lower portion (Pl. V. fig. 6, *p.*), and a

short thin tube above (*v.d.*), which probably represents the vas deferens. In *Schizoglossa*, according to Hedley (5, p. 390), the penis is "represented by a slight bulbous swelling near the orifice, a vas deferens arising therefrom, and a short muscle attaches this swelling to the nearest point of the body-wall." In *Apera* there is a large and peculiarly shaped receptaculum seminis; its lower portion, forming the receptacular duct, opens into the vagina as a wide sac, above this it becomes narrowed, the receptaculum seminis here commencing and forming a large hook-shaped body (Pl. V. fig. 6, *r.s.*). The free oviduct is about the same length as the penis and vas deferens together, only slightly wider; it forms the direct continuation of the vagina (Pl. V. fig. 6, *f.ov.*). The common duct is of considerable length, much convoluted and folded upon itself. The albumen-gland is pyriform in shape and of median size. The hermaphrodite duct is a long tube slightly coiled in its upper portion. The hermaphrodite gland consists of a series of glandular clusters, the outer portions of which are villous (Pl. V. fig. 6, *h.gl.*).

References.

1. Agassiz, L. Nomenclator Zoologicus (Mammals), 1842.
2. Binney, W. G. "On the Jaw and Lingual Dentition of certain Terrestrial Mollusks." Bull. Mus. Comp. Zool. Camb., U.S.A., 1879, p. 331.
3. Collinge, Walter E. "The Morphology of the Generative System in the Genus *Testacella*." Ann. & Mag. N. H. 1893, vol. xii. pp. 21–25, pl. i.
4. Godwin-Austen, H. H. "On the Molluscan Genus *Paryphanta*, and on the Anatomy of *P. Hochstetteri*, Pfr." Proc. Malac. Soc. 1893, vol. i. pp. 5–9, pl. i.
5. Hedley, Charles. "*Schizoglossa*: a new Genus of Carnivorous Snails." Proc. Linn. Soc. N. S. W. 1892, vol. vii. pp. 387–392, pl. ix.
6. Heynemann, D. F. "Ueber *Chlamydephorus*, Binney." Jahrb. d. d. malak. Gesell. 1885, Jh. xii. pp. 17–20, T. 2.
7. Lacaze-Duthiers, H. de. "Histoire de la *Testacelle*." Arch. Zool. exp. et gén. 1887, t. v. pp. 458–596, pls. xxix.–xl.
8. Smith, Edgar A. "Description of a New Species of Slug from South Africa." Ann. & Mag. N. H. 1892, vol. x. pp. 465–466.
9. Wagner, A. J. "Die Arten des Genus *Daudebardia*, Hartmann, in Europa und Westasien." Denksch. Akad. Wiss. Wien, 1896, Bd. lxii. pp. 609–626, 5 pls.

EXPLANATION OF PLATE V.

Fig. 1. View of posterior portion of the dorsum of *Apera Burnupi*, E. A. S., showing dorsal opening.
Fig. 2. The alimentary canal, &c.
Fig. 3. The pedal gland, viewed from above.
Fig. 4. Transverse section of the same.

Fig. 5. Dart-like chitinous (?) bodies found in the walls of the pedal gland.
Fig. 6. The generative organs.

Lettering.

alb.gl. Albumen gland.	*p.* Penis.
b.c. Buccal cavity.	*pr.* Prostate.
c. Crop.	*r.d.* Receptacular duct.
f.ov. Free oviduct.	*rect.* Rectum.
h.d. Hermaphrodite duct.	*r.s.* Receptaculum seminis.
h.gl. Hermaphrodite gland.	*s.d.* Salivary duct.
int. Intestine.	*s.gl.* Salivary gland.
m. Muscle.	*st.* Stomach.
œ. Œsophagus.	*v.d.* Vas deferens.
ov. Oviduct.	*vg.* Vagina.

XXII.—*Description of a new* Papilio *from Bali of the* nox *group.* By Lionel de Nicéville, F.E.S., C.M.Z.S., &c.

The butterfly described below comes into Section B of the *nox* group of *Papilios* as defined by the Hon. Walter Rothschild in 'Novitates Zoologicæ,' vol. ii. p. 258 (1895), which is characterized by the margin of the abdominal fold of the hind wing in the male, when fully expanded, having a fringe of long hairs*; the basal partition of the subcostal nervure of the same wing in both sexes is short; and the abdomen in both sexes black, or red only at the apex. All the females of this section (except the species described below, which was unknown to Mr. Rothschild) are said by that writer to have the upperside of the fore wing "brown"; but *P. erebus*, Wallace, which I have from Sumatra only (it occurs also in the Malay Peninsula and in Borneo), certainly is dark blue-black as in *P. nyx*, and Westwood says the female of *P. erebus* is "black above"; while the latter eminent entomologist says also that his *P. strix*, which is the female of his *P. noctula*, is "black" above. I would reconstruct Mr. Rothschild's key to the females of the group (including *P. nyx*) as follows, adding that I have not seen specimens of *P. noctis* and *P. noctula*:—

A. Upperside, both wings brown.
  a. Upperside, hind wing uniform brown.
    1. *P. nox*, Swainson: Java.
  b. Upperside, hind wing with a band of dirty white near the outer margin.
    2. *P. noctis*, Hewitson: Borneo.

* Mr. Rothschild says his Section A also has a fringe of long hairs. This, however, is a clerical error; all the species in the Section lack these hairs.